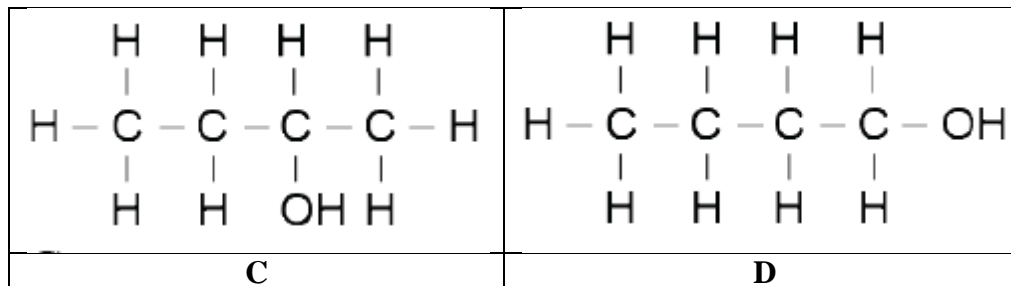


## ANSWERS: Markivnokov's Rule

1) Available in April 2014

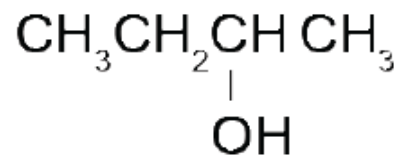
2)



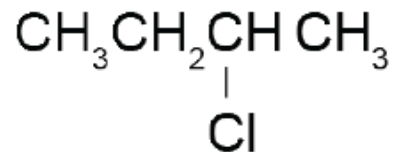
**C** is the major product and **D** is the minor product.

There are 2 possible products because when the double bond is broken, an H (or –OH) will bond to one C (and a –OH group (or H) will bond with the other C). The product will depend on which (C) the H (or the –OH) bond to.

**C** must be

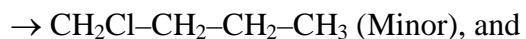
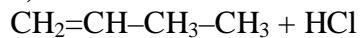


since product **E** is



i.e. both functional groups are on the second carbon atom. If  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$  was **C** then **E** would be  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl}$ .

### 3) Reaction of HCl with but-1-ene



### Reaction of HCl with but-2-ene



Both reactions are addition reactions. An addition reaction involves breaking the double bond between the carbon atoms, forming a carbon to carbon single bond. One H atom adds to one of the C atoms and Cl adds to the other C atom.

But-1-ene reacts to form two products, as the molecule is unsymmetrical. A major and minor product forms, as the chlorine atom can add to either the first or second carbon making two different products. The major product occurs when the hydrogen atom adds to the carbon atom (the 1st carbon) in the double bond that already has the most hydrogen atoms attached to it. Therefore the chlorine atom adds to the second carbon. The minor product has the hydrogen on the second carbon atom and the chlorine on the first carbon atom.

But-2-ene only has one product, as the molecule is symmetrical. This means it does not matter which carbon atom the hydrogen and chlorine atom add to as the chlorine will always be in the third position.

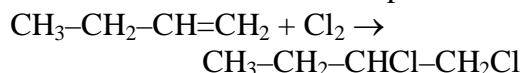
**4)** Both reactions are addition reactions. **This involves breaking the double bond between the carbon atoms** in but-1-ene and forming a single bond in its place, as well as forming two new single bonds.

With  $\text{Cl}_2$ , the new single bonds formed are both C-Cl bonds.

With HCl, the new single bonds are a C-Cl bond and a C-H bond.

### With $\text{Cl}_2$

But-1-ene reacts to form one product



### With HCl

But-1-ene reacts to form two products.

This is because but-1-ene is an asymmetric alkene (one carbon atom of the double bond has different groups attached to it).

$\text{CH}_3\text{-CH}_2\text{-CHClCH}_3$  is the major product because the H from HCl will bond to the carbon atom with the greatest number of H atoms.

